Executive functioning and ecological validity in fMRI, neuropsychological assessment and rehabilitation

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Introduction

This thesis describes a search for ecological validity in the research on and the rehabilitation of executive functioning. The main reason why this issue deserves attention lies in the fact that executive functions are essential in our everyday life as they allow us to act independently. These functions enable a person to intentionally initiate and regulate new patterns of behaviour and ways of thinking, and to introspect upon them. All of this covering a long period of time, without external cueing, often involving ill-structured situations and the activation of delayed intentions. As can be expected, executive functioning is required most in novel, non-routine situations or in situations where the usually performed, routine behaviour is no longer useful or appropriate. Consequently, besides in normal daily life, executive functions are indispensable in the rehabilitation process after brain injury. Therefore both assessment and treatment of executive functioning problems deserve a great deal of attention.

A second reason is that many measures of executive functioning have proven to fall short in the estimation of a person's executive functioning in daily life situations. Assessment is mainly done with neuropsychological tests. More recently, functional neuroimaging is applied to study the neural basis of executive functioning. Improvements in this technique have resulted in increasingly detailed information on the brain processes underlying cognitive functions and with that more and more researchers, many of which neuropsychologists, include it in their research design. Neuropsychology has really profited from this progress as it is the field that connects neural function with behaviour. More specific, the neural mechanisms behind recovery of function after brain injury have become a subject of interest for neuropsychologists. However promising the technique may seem, it also presents researchers with many restrictions that make ecological validity of the tests used questionable. Concluding, in many cases a person's level of executive functioning or his brain activation during executive functioning is being estimated on the basis of tests that are not ecologically valid.

Several studies were performed within the present research project. In the first chapter, an introduction is given on executive functioning and its rehabilitation after brain injury. Ecologically valid measurement of executive functioning is discussed in the context of traditional neuropsychological assessment and of functional neuroimaging. In chapter two the development and evaluation of an fMRI test of executive functioning is described. The test is presented to a healthy control group and can been seen as a first step in designing a test of executive functioning with higher ecological validity than tests used up to now in fMRI. In chapter three, again the evaluation of a test of executive functioning described, but this time an office-based

test. It is presented to a large group of brain-injured patients with a dysexecutive syndrome and also this test is expected to be more ecologically valid than tests used thus far. In chapter four a multi-faceted treatment protocol for the dysexecutive syndrome is described. This treatment is designed to be clinically relevant: improving executive functioning in daily life. Patients' functioning is evaluated before and after treatment and compared to the functioning of patients receiving a control treatment. In chapter five, brain activation patterns of six stroke patients included in the experimental treatment are evaluated and related to their scores on neuropsychological tests and questionnaires before and after treatment. Finally in chapter six, the information gathered around the topic of ecological validity in executive functioning research is summarized and discussed. Suggestions for interesting further research are given as well as suggestions to improve research on executive functioning and clinical practice.

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